

menters, and for the accuracy, so far as was required for the purpose in hand, of his own experiments. His determination of the specific heat of air, pressure constant, and the specific heat of air, volume constant, furnished the data necessary for making Laplace's theoretical velocity agree with the velocity of sound experimentally determined. On the other hand, he was able to account for most puzzling discrepancies which appeared in attempted direct determinations of the differences between the two specific heats by careful experimenters. He pointed out that in experiments in which air was allowed to rush violently or *explode* into a vacuum, there was a source of loss of energy that no one had taken account of, namely, in the sound produced by the explosion. Hence in the most careful experiments where the vacuum was made as perfect as possible, and the explosion correspondingly the more violent, the results were actually the worst. With his explanations the theory of the subject was rendered quite complete.

Space fails, or I should mention in detail Mr. Joule's experiments on magnetism and electro-magnets, referred to at the commencement of this sketch. He discovered the now celebrated change of dimensions produced by the magnetisation of soft iron by the current. The peculiar noise which accompanies the magnetisation of an iron bar by the current, sometimes called the "magnetic tick," was thus explained.

Mr. Joule's improvements in galvanometers have already been incidentally mentioned, and the construction by him of accurate thermometers has been referred to. It should never be forgotten that *he first* used small enough needles in tangent galvanometers to practically annul error from want of uniformity of the magnetic field. Of other improvements and additions to philosophical instruments may be mentioned a thermometer, unaffected by radiation, for measuring the temperature of the atmosphere, an improved barometer, a mercurial vacuum pump, one of the very first of the species which is now doing such valuable work not only in scientific laboratories, but in the manufacture of incandescent electric lamps, and an apparatus for determining the earth's horizontal magnetic force in absolute measure.

Here this imperfect sketch must close. My limits are already passed. Mr. Joule has never been in any sense a public man; and, of those who know his name as that of the discoverer who has given the experimental basis for the grandest generalisation in the whole of physical science, very few have ever seen his face. Of his private character this is scarcely the place to speak. Mr. Joule is still amongst us. May he long be spared to work for that cause to which he has given his life with heart-whole devotion that has never been excelled.

In June, 1878, he received a letter from the Earl of Beaconsfield announcing to him that Her Majesty the Queen had been pleased to grant him a pension of 200*l.* per annum. This recognition of his labours by his country was a subject of much gratification to Mr. Joule.

Mr. Joule received the Gold Royal Medal of the Royal Society in 1852, the Copley Gold Medal of the Royal Society in 1870, and the Albert Medal of the Society of Arts from the hands of the Prince of Wales in 1880.

J. T. BOTTOMLEY

COAL-TAR

A Treatise on the Distillation of Coal-Tar and Ammoniacal Liquor, and the Separation from them of Valuable Products. By George Lunge, Ph.D., F.C.S., Professor of Technical Chemistry in the Federal Polytechnic School, Zurich. (London: Van Voorst, 1882.)

A couple of centuries have just elapsed since the first English patent was granted to Becker and Serle for "a new way of making pitch and tarre out of pit coale, never before found out or used by any other"; and in 1742 a second patent was obtained by M. and T. Betton for the manufacture of "an oyle extracted from a flinty rock for the cure of rheumatick, and scorbutick, and other cases." Whether we have here a foreshadowing of the antiseptic method of treatment is impossible to say, but that there was virtue of another sort in coal-tar was fully recognised by the Earl of Dundonald, the father of brave Lord Cochrane, who, towards the close of the last century, set up tar ovens on a pretty extensive scale in Ayrshire.

What we know as the coal-tar manufacture is however practically an industry of the present generation; it is not even contemporaneous with that of the making of coal-gas, for during the earlier years of that manufacture the tar was counted as the most noxious of bye products to be got rid of by being burnt under the retorts or by being turned into the nearest stream. We have changed all that however, and to-day the tar is among those substances which, as Dr. Siemens pointed out the other day at Southampton, make the products of the destructive distillation of coal so much more valuable than the coal itself.

England is the great tar-producing country of the world; at the present time about half a million tons of tar are produced annually throughout Europe, of which we make about three-fifths. The distillation of coal-tar as a starting-point in the manufacture of colouring matters has indeed become one of our most important chemical industries. We however do not make these colouring matters although we are the principal users of them. Although Faraday first discovered benzene, and Mansfield gave his life in showing us how to isolate that substance on the large scale, and although Perkin led the way by the discovery of aniline purple, the first coal-tar colour; nevertheless the manufacture of the so-called coal-tar dyes has mainly centred itself in Germany. We send to the Germans the crude material, and they return to us the finished products. At the same time we also supply many of the chemicals necessary to transmute the baser substances into the costly dyes. In fact in this matter we are as mere hewers of wood and drawers of water; a circumstance which doubtless has not escaped the attention of the Royal Commissioners who are to report on the technical education of this country. We have not far to seek in tracing the cause of this: it is simply owing to the extraordinary development of chemical research in Germany arising largely from the attitude of the German universities towards scientific inquiry.

We have to thank Prof. Lunge for what is in reality the only monograph on this subject of tar distilling either in our own or in any continental language. Probably no one more fitted, both from practical experience and scien-

tific knowledge, could have been found to undertake the work. Already in 1867 Dr. Lunge had published a treatise in German on the subject; this has now been elaborated into the present excellent work, which describes the processes of manufacture as carried on in the largest and best arranged tar and ammonia works in England and the Continent. In the preparation of the newer work the author has received much assistance from Mr. Watson Smith, who has extensive knowledge of these processes as carried out in Lancashire.

Chapter I. is mainly concerned with the origin of coal-tar; with historical notes on its applications, and with the general characters of the tars obtained from various sources. Much in this chapter, as indeed in other parts of the work, is of direct interest to the gas-engineer. An iron smelter has been defined as one who makes slag, and the economical production of cast-iron is very much a question of the economical production of the proper sort of slag. So important indeed are, nowadays, the "residual" products in the manufacture of coal-gas that a gas-engineer may with even greater truth be described as a maker of coal-tar and ammonia-water, and we fully agree with Dr. Lunge that with the electric light looming in the near future, gas managers will have to consider the market prices of these "residuals," as influencing the mode of their manufacture, more carefully than they have hitherto done. They must in fact recognise that they are just as much makers of tar and ammonia as of coal-gas, and whether the one or the other is to be worked for must be governed by calculations depending upon the relative prices of gas and tar.

Chapter II. deals mainly with the properties of coal-tar and its constituents. A very complete list of these is given, and special attention is paid to their physical characters whenever these have been ascertained. Benzene, of course, is very fully described, even to an account of the rival theories of Kekulé, Claus, and Ladenburg as to its constitution. We entirely endorse Dr. Lunge's recognition of the enormous value of Kekulé's famous hypothesis in the development of the history of the aromatic derivatives; nevertheless the average tar distiller will, we are afraid, be lost in wonder and amazement at the idea of such fruitful consequences flowing from pictures of hexagons and prisms. In other words the description on p. 40 of the chemical constitution of the parent member of the aromatic group is far too bald to be of the slightest use to persons ignorant of the modern methods of representing constitution, and conveys no new information to those who know anything of such matters.

Chapter III. treats of the applications of coal-tar without distillation, such as its use for gas making, heating, and for the preservation of building materials and its use as an antiseptic, and in the manufacture of paints, varnishes, &c. Chapter IV. deals with the methods of distilling coal-tar, such as its distillation by steam and by fire. This and the next chapter (Chapter V.), on pitch, are extremely well illustrated by cuts and plates showing the best methods of constructing stills and condensing apparatus, mode of treating the gases and the different fractions, and a series of most valuable figures and tables are given of the results obtained in various works in England and on the Continent from different tars. Chapters VI. and VII. treat of anthracene and creosote

oil, and considerable attention is given to the important question of the quantitative determination of anthracene and of the so-called coal-tar acids. Chapter VIII. is concerned with phenol or carbolic acid and naphthalene, and contains many valuable details as to the manufacture of carbolic acid hitherto unpublished: we would especially instance the careful description of the manufacture of pure phenol, as carried on in Lancashire which is furnished by Mr. Watson Smith. Chapters IX. and X. treat of what is technically known as "light oil" or "crude naphtha," and of its rectification by steam. The last chapter (Chap. XI.) is entirely devoted to the subject of gas-liquor, or the ammoniacal liquor obtained at the gas works by condensation in the hydraulic main and by washing the gas in the scrubbers. Ammonia is in fact one of the most important products of the destructive distillation of coal; indeed the supply falls very far short of the demand made by the employment of ammoniacal salts in artificial manures and in the manufacture of soda ash by the modern method. The price of sulphate of ammonia has been practically doubled within the last twenty years. Whether ammonia will ever be produced commercially from the nitrogen of the air is a vexed question, but there is no doubt that if the coking of coals could only be carried out in a rational manner we might count upon an important addition to our stock of ammonia and of tar. It is indeed to this source that we must more immediately look for the increased supply so urgently needed.

Dr. Lunge has already enriched our literature by a most valuable treatise on another of our most important chemical industries, viz. the manufacture of alkali, and he has still further added to our debt by the publication of the present excellent manual. The work is extremely well got up, and deserves to be on the table of every gas manager and tar distiller in the kingdom.

T. E. THORPE

OUR BOOK SHELF

Tables for the Qualitative Analysis of "Simple Salts" and "Easy Mixtures." By Joseph Barnes. (Manchester: James Galt and Co.; London: Simpkin, Marshall, and Co., 1882.)

THESE tables are evidently compiled by one who has had considerable experience in teaching qualitative analysis; the directions are always clear and to the point; the student is not confused by too many alternative methods, neither is the art of analysis made altogether a matter to be learnt by rote. The short and simple solubilities table on p. 37 is especially to be commended. If we must have yet another set of tables for elementary qualitative analysis let us have these by Mr. Barnes; but have we not sufficient already?

LETTERS TO THE EDITOR

- [The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]
- [The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

The Comet

AT 4.30 this morning this comet was a most conspicuous and lovely object in the clear sky, in the south-east. With the